

What is claimed is:

- 5 1. An full-duplex optical communication system comprising:
 a transmitter for transmitting a linearly polarized electromagnetic beam to an object;
 a first quarter-wave plate for converting the linearly polarized beam into a circularly
 polarized beam;
 a signal collection apparatus for directing the beam to the object and collecting the beam
10 returned from the object;
 a retro-modulator for directing the beam incident on the object back to said signal
 collection apparatus and for assigning left-handed and right-handed circular polarizations to the returned
 beam according to binary data bit information;
 an aperture sharing element for separating the transmitted and returned electromagnetic
15 beams;
 a second quarter-wave plate for converting the left and right-handed circularly polarized
 beams into two orthogonally polarized beams respectively; and
 at least one beam splitter for separating the two orthogonally polarized beams.
20 2. The system of claim 1 wherein said transmitter comprises a diode laser.

 3. The system of claim 1 wherein said aperture sharing element comprises a mirror with an
 opening defined therein.

25 4. The system of claim 1 wherein said retro-modulator comprises a liquid crystal retro-
 modulator.

5. The system of claim 1 wherein said at least one beam splitter comprises:

a first beam splitter for sending less than 1 percent of the returned beam from said aperture sharing element to a first FADOF and the remaining portion of the returned beam to said second quarter-wave plate; and

- 5 a second polarizing beam splitter for separating the two orthogonally polarized beams.

6. The system of claim 5 further comprising:

a second FADOF for receiving one of the orthogonally polarized beams from said second polarizing beam splitter;

- 10 a third FADOF for receiving the other of the orthogonally polarized beams from said second polarizing beam splitter; and

means for subtracting the orthogonally polarized beams.

7. The system of claim 1 wherein said system is capable of achieving a data rate of up to

- 15 10 kbps with a signal-to-noise-ratio greater than 2,100.

8. The system of claim 1 wherein said transmitter transmits a beam having a signal power less than or equal to 0.2 watts.

- 20 9. A method of full-duplex electro-magnetic communication, the method comprising selecting a pair of data modulation formats for the forward and return data links respectively such that the forward data electro-magnetic beam also serves a carrier for the return data.

10. The method of claim 9 further comprising the steps of:
transmitting a linearly polarized electromagnetic beam to an object;
converting the linearly polarized beam into a circularly polarized beam;
directing the beam to the object and collecting the beam returned from the object;
5 assigning left-handed and right-handed circular polarizations to the beam incident on the
object according to binary data bit information;
separating the transmitted and returned electromagnetic beams;
converting the left and right-handed circularly polarized beams into two orthogonally
polarized beams respectively; and
10 separating the two orthogonally polarized beams.

11. The method of claim 9 wherein the step of transmitting comprises transmitting with a
diode laser.

12. The method of claim 9 wherein the step of separating the transmitted and returned
electromagnetic beams comprises separating with an aperture sharing element comprising a mirror with
an opening defined therein, through which the transmitted and returned beams pass.

13. The method of claim 9 wherein the step of assigning left-handed and right-handed
20 circular polarizations to the beam incident on the object according to binary data bit information
comprises flipping the incident right-hand polarized beam into a left-hand polarized beam to represent a
first binary state and leaving the incident right-hand polarized beam unchanged for the second binary
state.

14. The method of claim 9 wherein the step of separating the transmitted and returned
25 electromagnetic beams further comprises sending less than 1 percent of the returned beam to a first
FADOF and the remaining portion of the returned beam to a second quarter-wave plate to be converted
into the two orthogonally polarized beams.

15. The method of claim 14 wherein the step of separating the two orthogonally polarized beams comprises:

receiving one of the orthogonally polarized beams at a second FADOF;

5 receiving the other of the orthogonally polarized beams with a third FADOF; and

subtracting the orthogonally polarized beams received by each of the FADOFs.

16. The method of claim 9 further comprising the step of achieving a data rate of up to 10 kbps with a signal-to-noise-ratio greater than 2,100 during the optical communication.

17. The method of claim 9 wherein the step of transmitting a linearly polarized electromagnetic beam to an object comprises transmitting a beam having a signal power less than or equal to 0.2 watts.

18. A method of encoding optical information, the method comprising the step of assigning right-hand and left-hand circular polarizations to represent binary states.